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New records of isopods (Crustacea: Peracarida: Isopoda) from the Mesoamerican Reef at Puerto Morelos, Quintana Roo, Mexico

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Abstract: New distribution records are presented for 19 species of isopods that are recorded for the Mexican Caribbean coast for the first time. The sampling program was conducted in three sites and at three different depths in each site within the Arrecife de Puerto Morelos Nature Reserve. The new records belong to 10 families and 15 genera in the suborders Asellota, Cymothoida and Sphaeromatidea. With the new records included herein isopods could be the most diverse group of peracarid crustaceans found in the Puerto Morelos Reef.

Key words: Asellota; Cymothoida; Sphaeromatidea; Mexican Caribbean

INTRODUCTION

The Mesoamerican Reef, in the western Caribbean, has been recognized for its socioeconomic importance and as a productive system that supports a great diversity of species (Briones and Machain 2005). As part of a larger project designed to compare reef sections with high use and of high conservation value in the Puerto Morelos area in the Mexican state of Quintana Roo, a sampling program of cryptofauna was undertaken from January 2013 to January 2014. Three sites were selected (conserved, in recovery, and degraded) considering the assessments made by the local environmental authority, and the cryptofauna associated with coral rubble was collected at three depths and identified.

We take the Mexican Caribbean to be the area between Cape Catoche, the northeast tip of the Yucatan Peninsula, to Xcalak, Quintana Roo, at the border with Belize, a coastline of approximately 418 km. In general, the diversity of marine isopods from the Mexican Caribbean is poorly known. While few studies have dealt with isopods from this area, there are numerous records for the group from the Greater Caribbean where more than 300 species have been recorded (Kensley and Schotte 1994). The most extensive work on crustaceans is that of Markham et al. (1990) who reported a total of 309 species, 41 of which were isopods, including 21 new records, from the Mexican Caribbean coast from Cancun to Chetumal.

Barriga and Briones (1992) reported eight species of *Excorallana* from the Gulf and the Caribbean coasts of Mexico. From the Puerto Morelos reef lagoon, Quintana Roo, van Tussenbroek and Brearley (1998) reported the isopod *Limnoria simulata* Menzies, 1957 (Limnoriidae) burrowing in the turtle grass *Thalassia testudinum* Banks ex König forming canal systems, using the burrows for reproduction. Campos-Vázquez (2000) collected crustaceans associated with macroalgae in Bajo Pepito, Isla Mujeres, Mexican Caribbean and found Isopoda to be the most abundant group and eight species were identified. Van Tussenbroek et al. (2012) investigated meso-faunal invertebrates visiting male and female flowers of the seagrass *Thalassia testudinum* at night in the Puerto Morelos reef lagoon, on 76 flowers they found 57 species of crustaceans, eight of them isopods, including two new records.

The main goal of the larger study, from which this particular report is derived, was to compare the diversity and abundance of cryptofauna with the degree of conservation of each site. As the identification of the cryptofauna progressed, many new distributional records of species were obtained. In this report we present 19 new records of isopods for the Mexican Caribbean coast. Photographs of each of the 19 species are also presented because for most of them just the drawings of the original description are available.

MATERIALS AND METHODS

The study was conducted in the Puerto Morelos Reef National Park (PNAPM), Quintana Roo, Mexico, which is a section of the Mesoamerican Reef (Figure 1). Three sites were selected: 1) Bonanza (20°57′58″ N, 086°48′27″ W), in recovery, located in the northern section of the

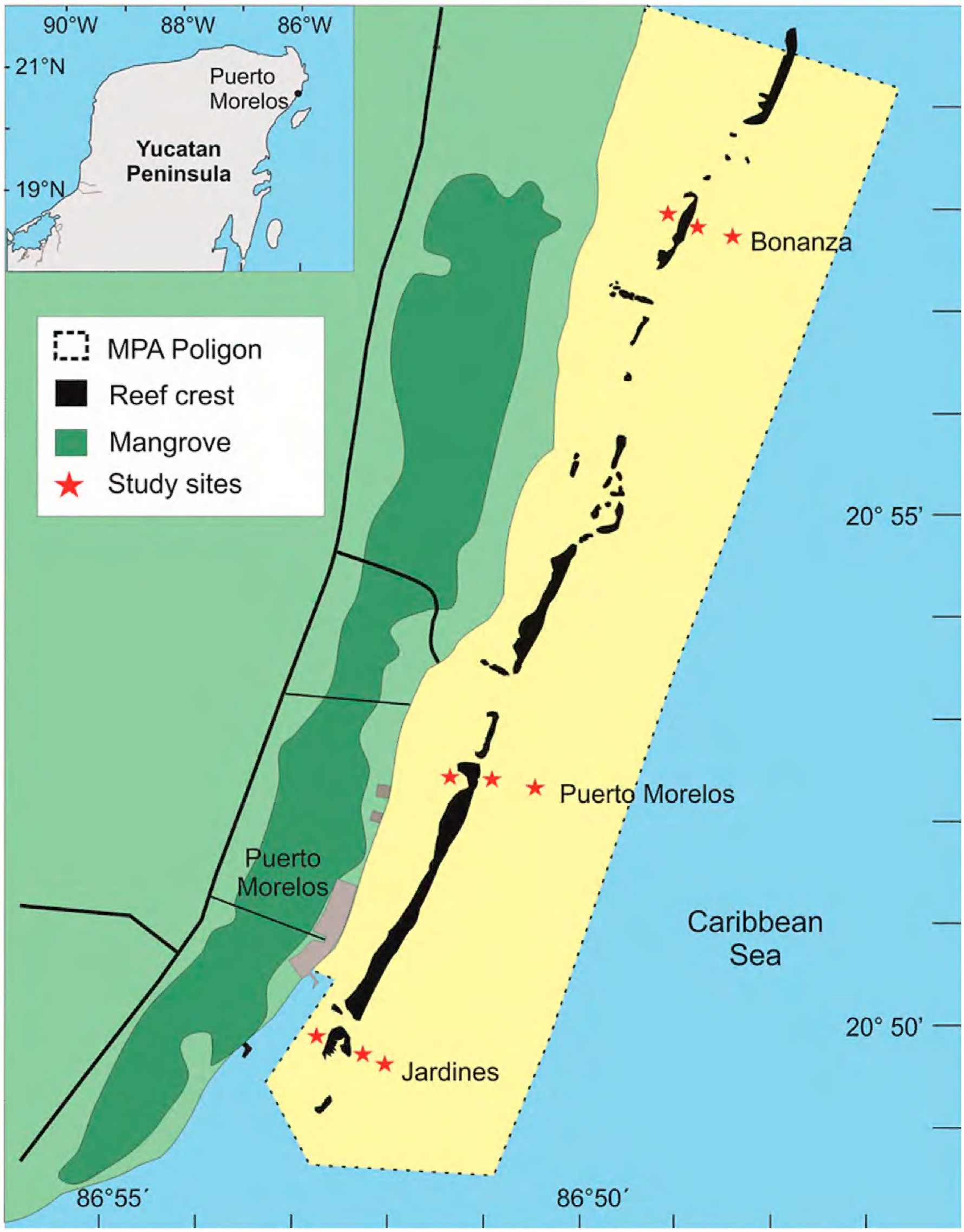

Figure 1. Map of the Puerto Morelos Reef National Park, Quintana Roo, Mexico, showing the collecting sites for this study: Bonanza, Puerto Morelos and Jardines. MPA stands for "Marine Protected Area".

marine park, now closed to recreational activities after being heavily impacted; 2) Puerto Morelos (20°52′50″ N, 086°51′02″ W), conserved, in the central portion of the marine park, is in good condition although it is adjacent to the town of Puerto Morelos; and 3) Jardines (20°50′20″ N, 086°52′41″ W), degraded, it lies the southern section of the park in front of large resorts and golf courses with a heavy sediment load (Figure 1). Using SCUBA equipment, 3 kg of coral rubble were sampled at each site at three depths: shallow, 2–3 m; medium, 6–7 m; and deep, 10–12 m. Samplings were conducted in March, May, August, and November 2013, and January 2014, under SAGARPA (Agriculture, Natural Resources and Fisheries Secretariat) collecting permit DGOPA.00008.080113.0006 granted to F. Alvarez.

Samples were sorted in the laboratory. All organisms

were extracted from the coral matrix, the remaining washings sieved through a 0.5 mm mesh, and preserved in 70% ethanol. The identification keys used were Menzies and Glynn (1968), Kensley (1984a), Kensley and Schotte (1989), and Müller (1989, 1992, 1993). The list of species follows the taxonomic arrangement by Ahyong et al. (2011). Specimens were sexed and their total length measured in millimeters. Specimens of less than 2 mm in total length were photographed in an Axio Zoom V16 Zeiss microscope, and larger specimens in a Z16 APO-A Leica microscope. All specimens are deposited in the National Crustacean Collection (CNCR) of the Institute of Biology, National Autonomous University of Mexico (UNAM).

RESULTS

Order Isopoda
Suborder Asellota Latreille, 1802
Superfamily Gnathostenetroidoidea Kussakin, 1967
Family Gnathostenetroidae Fresi, Idato & Scipione, 1980

Genus *Gnathostenetroides* Amar, 1957

Gnathostenetroides pugio Hooker, 1985
(Figure 2a)

Material examined: 4 females, mean 1.8 mm; Jardines (deep); 6 May 2013; CNCR 30576. 3 females, mean 1.6 mm; Bonanza (deep); 6 May 2013; CNCR 30577.

Distribution: United States, Florida Middlegrounds in the Gulf of Mexico, at a depth of 55 m (Hooker 1985; Kensley and Schotte 1989); Venezuela, Cayo Sombrero, in Morrocoy National Park, at 15 m (Díaz et al. 2013).

Remarks: Twenty-four individuals have been identified; 14 of them came from the May sampling at Bonanza. The two examined specimens agree well with the original description, although one (Figure 2a) presents slight variations: a more elongated habitus and a subacute pleotelson. *Gnathostenetroides* includes two species: *G. pugio* and *G. laodicense* Amar, 1957 from the Mediterranean Sea (Fresi et al. 1980).

Superfamily Janiroidea Sars, 1897
Family Joeropsididae Nordenstam, 1933
Genus *Joeropsis* Koehler, 1885

Joeropsis bifasciatus Kensley, 1984a
(Figure 2b)

Material examined: Male, 2.3 mm; Jardines (shallow); 6 May 2013; CNCR 30578.

Distribution: Belize, Carrie Bow Cay, 1–6 m (Kensley 1984a).

Remarks: The species was previously known only from Belize, so the present record increases its distribution 470 km to the north. The main characteristic that identifies this species is the presence, in live or freshly captured organisms, of two pigmented bands one on the head and one on pereonite IV.

The genus *Joeropsis* is well represented in coral reef habitats, often with three or more species co-occurring. Five primary characters serve to discriminate among species: pigmentation pattern, body setation, presence or absence of a serrate cephalon, presence or absence of a serrate pleotelson, and rostrum shape (Kensley et al. 1997).

Joeropsis rathbunae Richardson, 1902
(Figure 2c)

Material examined: Male, 1.6 mm, female, 1.5 mm; Puerto Morelos (shallow); 6 May 2013, 6 August 2013; CNCR 30563, 30816.

Distribution: Bermuda (Richardson 1902). Bahamas, Andros Island, 2–3 m (Boyko and Williams 2004). Belize, Carrie Bow Cay, 1–6 m (Kensley 1984a). Puerto Rico (Kensley 1984a). United States, Sanibel Island and Looe Key, Florida, subtidal to 36 m (Kensley 1984a). Mexico, Veracruz, Tuxpan, 5–25 m; Yucatán, Sisal, 1–20 m (Ortiz et al. 2013, 2014). Colombia, Bahía de Guachaquita, Arrecife Cañaverales, 25–30 km northeast of Santa Marta, 6–13 m (Müller 1989). Tobago (Kensley and Schotte 1994).

Remarks: The specimens agree with the diagnosis. Kensley (1994: 325) reported some differences in relation to the color pattern of two male syntypes from Bermuda: "faintly reticulate over entire body, strong dark brown pigment on most of cephalon and pereionite 4". The specimens from the PNAPM have a brown pigmentation over the full body. Pigment patterns presumably have some camouflage function in reef rubble habitats (Kensley et al. 1997).

Family Munnidae Sars, 1897
Genus *Uromunna* Menzies, 1962

Uromunna reynoldsi (Frankenberg & Menzies, 1966)
(Figure 2d)

Material examined: Male, 1.3 mm, female 1.1 mm; Puerto Morelos (shallow); 6 May 2013; CNCR 30558.

Distribution: United States, Georgia, Sapelo Island; Louisiana, Lake Ponchartrain (Frankenberg and Menzies 1966). Gulf of Mexico (Schotte et al. 2009). Mexico, Tuxpan, 5–25 m; Yucatan, Sisal, 1–20 m (Ortiz et al. 2013, 2014). Panama, Pacific and Caribbean coasts at Panama Canal (Kensley and Schotte 1989).

Remarks: There are currently 23 known species in the genus, two of them distributed in the Caribbean, *U. caribea* and *U. reynoldsi*. The main difference between the Caribbean species is the size proportion of the propodus of pereopod I, it is 1.5–2 times longer than wide in *U. caribea* and 2–3 times longer than wide in *U. reynoldsi* (Kensley and Schotte 1989).

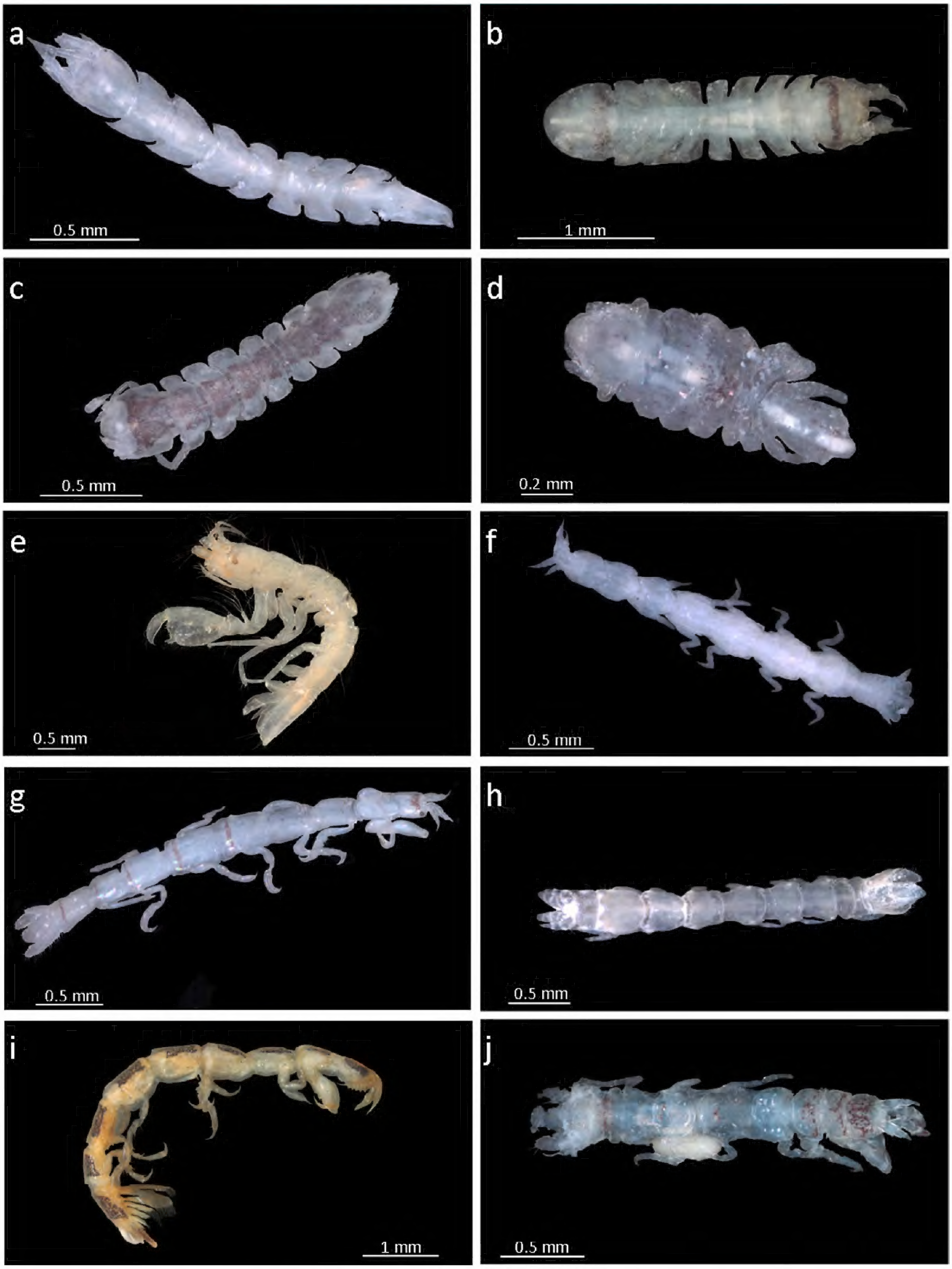

Figure 2. Isopods that represent new records for the Mexican Caribbean coast: **a**. *Gnathostenetroides pugio*; **b**. *Joeropsis bifasciatus*; **c**. *Joeropsis rathbunae*; **d**. *Uromunna reynoldsi*; **e**. *Hansenium spathulicarpus*; **f**. *Amakusanthura magnifica*; **g**. *Amakusanthura signata*; **h**. *Cortezura confixa*; **i**. *Mesanthura bivittata*; **j**. *Pendanthura hendleri*.

Superfamily Stenetroidea Hansen, 1905
Family Stenetriidae Hansen, 1905
Genus *Hansenium* Serov & Wilson, 1995

Hansenium spathulicarpus (Richardson, 1902)
(Figure 2e)

Material examined: Male, 3.9 mm; Jardines (shallow); 6 May 2013; CNCR 30831.

Distribution: Carrie Bow Cay, Belize intertidal to 36 m (Kensley 1984a). Puerto Rico, intertidal (Kensley and Schotte 1989).

Remarks: Apparently few specimens (6) of this species have been collected. This species could be confused with one of three West Indian species that form a complex, particularly if mature males are not available and the shape of the carpus and propodus of pereopod I is not examined carefully. These species are *H. stebbingi* Richardson, 1902 from Bermuda; *H. occidentale* Hansen, 1904 from St. Thomas, West Indies; and *H. antillense* Hansen, 1904 from the West Indies. In the male of *H. spathulicarpus* the carpus of pereiopod I is apically rounded (Kensley 1984a); in the specimen from the PNAPM the carpus is more oval shaped than that of the original description.

Suborder Cymothoida Wagele, 1989
Superfamily Anthuroidea Leach, 1814
Family Anthuridae Leach, 1814
Genus *Amakusanthura* Nunomura, 1977

Amakusanthura magnifica (Menzies & Frankenberg, 1966)
(Figure 2f)

Material examined: Female, 2.2 mm; Bonanza (medium); 7 November 2013; CNCR 30572.

Distribution: Bermuda (Kensley 1994). United States, New Jersey to Alabama, 1–206 m (Schotte et al. 2009). Cuba, Gulf of Mexico (Kensley and Schotte 1989). Bahamas, Andros Island, 2–3 m (Boyko and Williams 2004).

Remarks: This species was previously classified as *Apanthura magnifica* due to a considerable confusion regarding the status of the genera *Apanthura* and *Amakusanthura* (Poore and Lew Ton 1988). The main features that distinguish these genera, in the case of females, are for *Apanthura*: pleonites 1–5 dorsally indistinguishable, except in some males; and for *Amakusanthura*: pleonites, except 4–5, distinguished by dorsal grooves, rarely 1–5 indistinguishable (Poore and Lew Ton 1988).

Amakusanthura signata (Menzies and Glynn, 1968)
(Figure 2g)

Material examined: Female, 3.1 mm; Bonanza (shallow); 7 November 2013; CNCR 30568.

Distribution: United States, Georgia, Florida, intertidal to 1.5 m (Schotte et al. 2009). Mexico, Yucatan, Sisal, 1–20 m (Ortiz et al. 2014). Belize, Carrie Bow Cay, intertidal to 24 m (Kensley and Schotte 1989). Cuba, Puerto Rico (Kensley and Schotte 1989). Colombia, Dominica (Kensley and Schotte 1994).

Remarks: *Amakusanthura signata* can be easily distinguished from all the other species of this genus by the presence of chromatophores on the cephalon, pereonites and pleon. *A. signata* and *A. magnifica* have been previously recorded in the Gulf of Mexico (Kensley and Schotte 1989). There are other three species in the Caribbean Sea (Müller 1992).

Genus *Cortezura* Schultz, 1977

Cortezura confixa (Kensley, 1978)
(Figure 2h)

Material examined: Female, 2.8 mm; Bonanza (shallow); 7 November 2013; CNCR 30571.

Distribution: Venezuela, Cubagua Island, 4–10 m (Kensley and Schotte 1989). Colombia
(Kensley and Schotte 1994).

Remarks: The present record extends the distribution of the species to the northwestern Caribbean. This species was originally described in the genus *Venezanthura* Kensley (1978), restricted to the southern Caribbean (Kensley and Schotte 1989). The other species of *Cortezura* is the type species of the genus, *C. penascoensis* Schultz, 1977, from the Gulf of California in Sinaloa, Mexico.

Genus *Mesanthura* Barnard, 1914

Mesanthura bivittata Kensley, 1987
(Figure 2i)

Material examined: Female, 5.8 mm; Bonanza (shallow); 6 March 2013; CNCR 30579.

Distribution: Belize, Twin Cays, 1–2 m (Kensley and Schotte 1989). Mexico, Tuxpan, 5–25 m (Ortiz et al. 2013).

Remarks: *Mesanthura bivittata* is the fourth species of the genus recorded for the Mexican Caribbean. All species of the genus have different color patterns, usually species-specific, pigment is persistent in alcohol preserved organisms (Kensley and Schotte 1989). The specimen collected shows the characteristic two dark dorsal bands on each segment.

Genus *Pendanthura* Menzies & Glynn, 1968

Pendanthura hendleri Kensley, 1984a
(Figure 2j)

Material examined: Male, 2.0 mm; Bonanza (deep); 7 May 2013; CNCR 30560.

Distribution: Mexico, Tuxpan, (Ortiz et al. 2013). Belize, Carrie Bow Cay, Twin Cays, 0–23 m (Kensley and Schotte 1989). Panama, 30 m (Kensley and Schotte 1989). Tobago (Kensley and Schotte 1994).

Remarks: The specimen reported here represents the first record of the species from Mexico, since the description made by Kensley (1984a). There are eight species in the world, from the Mediterranean Sea, Indian Ocean, Florida Middle Grounds and Gulf of Aden (Kensley and Schotte 2000). The other known western Atlantic representative is *P. tanaiformis* Hooker, 1985, which was reported from Quintana Roo by Markham et al. (1990).

Family Expanathuridae Poore, 2001
Genus *Eisothistos* Haswell, 1884

Eisothistos petrensis Haswell, 1884
(Figure 3a)

Material examined: Male, 2.9 mm; Bonanza (deep); 6 May 2013; CNCR 30569.

Distribution: St. Thomas, West Indies, St. James Bay, 10 m (Kensley 1984a). Belize, Carrie Bow Cay, subtidal to 36 m (Kensley 1984a). United States, Looe Key, Florida (Kensley and Schotte 1989). Turks and Caicos, 1 m (Kensley and Schotte 1989). U.S. Virgin Islands, St. Thomas, 7–10 m (Kensley and Schotte 1989).

Remarks: A single specimen of the species was found during the study, expanding the distribution of the species 480 km to the north from Carrie Bow Cay, Belize. The genus contains 30 species, two of them from the Caribbean Sea, *E. petrensis* and *E. teri* (Kensley and Schotte 1989).

Family Paranthuridae Menzies and Glynn, 1968
Genus *Colanthura* Richardson, 1902

Colanthura tenuis Richardson 1902
(Figure 3b)

Material examined: Female, 9.5 mm; Puerto Morelos (shallow); 6 August 2013; CNCR 30580.

Distribution: Bermuda (Kensley and Schotte 1989). Colombia (Kensley and Schotte 1994).

Remarks: This species has been previously recorded only from Bermuda and Colombia. Species of *Colanthura* are distinguished from those of related genera by the elongation of pleonite 1 and free pleonites. Their body surface is covered with minute squamae (Kensley and Schotte 1989).

Superfamily Cymothooidea Leach, 1814
Family Cirolanidae Dana, 1852
Genus *Calyptolana* Bruce, 1985

Calyptolana hancocki Bruce, 1985
(Figure 3c)

Material examined: Female, 3.0 mm; Jardines (shallow); 6 May 2013; CNCR 30561.

Distribution: Netherlands Antilles, Aruba Island, 43 m (Bruce 1985). Turks and Caicos (Schotte et al. 1991). Colombia, Santa Marta (Müller 1993). Venezuela, at Boca Grande and Las Luisas, in the Morrocoy National Park, subtidal to 25 m (Díaz et al. 2013). Tobago (Kensley and Schotte 1994).

Remarks: *Calyptolana hancocki* is an easily recognizable species due to the elliptical shape of the habitus; the endopod of pleopod I is longer and broader than the exopod. It is moderately abundant in the study area, 12 females have been found.

Genus *Metacirolana* Kussakin, 1979

Metacirolana menziesi Kensley, 1984a
(Figure 3d)

Material examined: Female, 2.4 mm; Puerto Morelos (shallow); 14 January 2014; CNCR 30815.

Distribution: Belize, Carrie Bow Cay, intertidal to 30 m (Kensley 1984a). Bahamas, Andros Island, 11 m (Boyko and Williams 2004).

Remarks: The morphology of our specimen fits well the original description, the chromatophores and the shape of the pleotelson and uropods are similar to those of the specimens from Belize (Kensley 1984a).

Family Gnathidae Leach, 1814
Genus *Gnathia* Leach, 1814

Gnathia beethoveni Paul and Menzies, 1971
(Figure 3e)

Material examined: Male, 1.8 mm; Bonanza (deep); 6 May 2013; CNCR 30567.

Distribution: Venezuela, Morrocoy National Park, subtidal to 25 m (Díaz et al. 2013). Colombia, area from Santa Marta to 25 km to the northeast, 13–30 m (Müller 1988; Kensley and Schotte 1994).

Remarks: This new record extends the range of *G. beethoveni* towards the northern Caribbean Sea. The species has been reported to depths of 95 m (Kensley and Schotte 1989). The species can be easily distinguished by the presence of 4 projections in the frontal border of the head. All current descriptions of gnathiid isopods are based on the morphology of free-living adult males; but their juvenile stages called "praniza larvae" a protelian ectoparasite that feed on fish host blood, limph or mucus, can be abundant in some areas and cannot be identified (Farquharson et al. 2012).

Gnathia vellosa Müller, 1988
(Figure 3f)

Material examined: Male, 2.7 mm; Puerto Morelos (medium); 6 May 2013; CNCR 30559.

Distribution: Colombia, Isla de Morro Grande, Santa Marta, 25–30 m (Müller, 1988; Kensley and Schotte 1994).

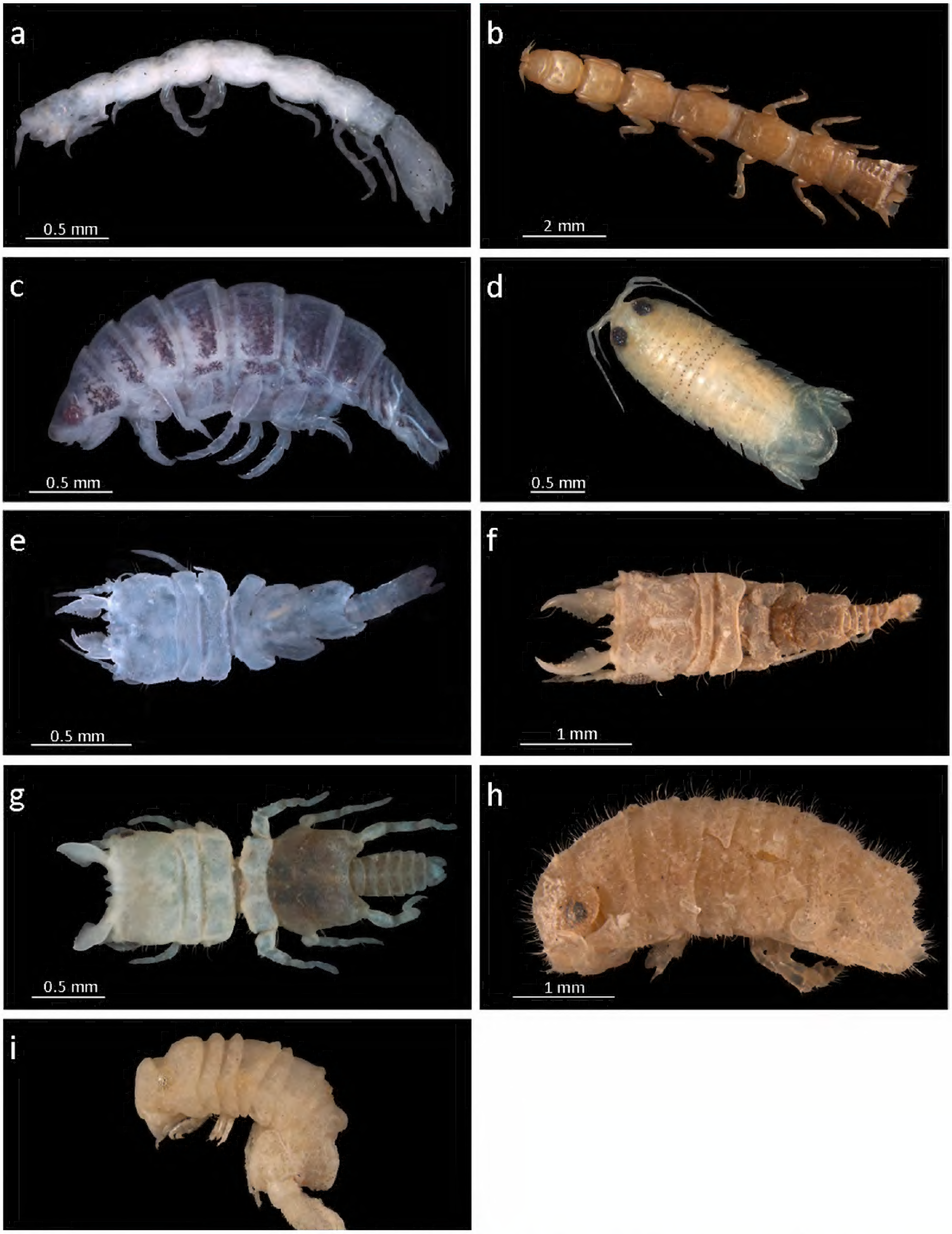

Figure 3. Isopods that represent new records for the Mexican Caribbean coast: **a**. *Eisothistos petrensis*; **b**. *Colanthura tenuis*; **c**. *Calyptolana hancocki*; **d**. *Metacirolana menziesi*; **e**. *Gnathia beethoveni*; **f**. *Gnathia vellosa*; **g**. *Gnathia virginalis*; **h**. *Exosphaeroma yucatanum*; **i**. *Geocerceis barbarae*.

Remarks: The present record increases the geographic distribution toward the northern Caribbean Sea. This species is related to *Gnathia virginalis* in having three projections at the anteromedial border of the cephalon, which along with the two free anterior pereonites have a granular surface. The two species can be distinguished as follows: in *G. vellosa* pereonites 5–6 are much narrower than the cephalon in dorsal view and the distal end of the mandible bears an acute larger tooth, in *G. virginalis* pereonites 5–6 are as wide as the cephalon and all teeth on mandible are of approximately the same size.

Gnathia virginalis Monod, 1926
(Figure 3g)

Material examined: Male, 2.2 mm; Puerto Morelos (medium); 7 November 2013; CNCR 30556.

Distribution: Colombia, area from Santa Marta to 15 km to the northeast, subtidal to 30 m (Müller 1988; Kensley and Schotte 1994).

Remarks: As stated above, *G. virginalis* seems to be closely related to *G. vellosa*, additional differences are: *G. virginalis* has a body size larger than *G. vellosa* whose mandibular carina is distally notched, and rounded in *G. virginalis* (Kensley and Schotte 1989).

Suborder Sphaeromatidea Wagele, 1989
Superfamily Sphaeromatoidea Latreille, 1825
Family Sphaeromatidae Latreille, 1825
Genus *Exosphaeroma* Stebbing, 1900

Exosphaeroma yucatanum (Richardson, 1901)
(Figure 3h)

Material examined: Female, 4.7 mm; Jardines (deep); 7 November 2013; CNCR 30573.

Distribution: Cape Catoche, Yucatan, Mexico (Kensley and Schotte 1989).

Remarks: The genus *Exosphaeroma* Stebbing, 1900, contains five Caribbean species. Our specimen agrees with the description in having the posterior margin of the pleotelson faintly trilobed, and three low rounded tubercles anteriorly. Our record is the first for the Caribbean Sea since the original description from a single specimen, which has since been lost, so the true generic placement of this species is thus undetermined and full description awaits the finding of more material (Kensley and Schotte 1989).

Genus *Geocerceis* Menzies & Glynn, 1968

Geocerceis barbarae Menzies & Glynn, 1968
(Figure 3i)

Material examined: Male, 3.8 mm; Bonanza (medium); 6 May 2013; CNCR 30570. Male, Jardines (shallow); 7 November 2013; CNCR 30555.

Distribution: Puerto Rico, Dominica (Kensley and Schotte 1994).

Remarks: The new records included in this study extend the range of *G. barbarae* to the western Caribbean Sea. This species appears to be common, 82 specimens have identified in our samples. The characters that identify the species are pleonite 5 with three dorsal tubercles, exopod of male uropod tubular and longer than pleon. Males with a frontal lamina expanded into ventrally directed beak-like process (Menzies and Glynn 1968; Kensley and Schotte 1989).

DISCUSSION

The existing records of isopods for the Mexican Caribbean coast combined account for 51 species (Markham et al. 1990; Barriga and Briones 1992; Campos-Vázquez 2000; van Tussenbroek and Brearley 1998; van Tussenbroek et al. 2012), but with our new records, the total number rises to 70 species. This number is likely to increase in the near future as the results of several ongoing investigations become available.

Geographically, the southern section of the Mexican Caribbean coast has been only superficially studied and will probably yield records of many more species when sampled thoroughly. Few records of isopods are available for the coast of the Sian Ka'an Nature Reserve, which occupies the central portion of the Quintana Roo coast, and from the southern portion of the state from Majahual to Xcalak. These two areas of central and southern Quintana Roo, where relatively undisturbed sections of the Mesoamerican Reef are found, should be surveyed to complete the inventory coastal peracarid species.

Most of the available records of isopods in the region are from the intertidal zone, and few samples come from deeper zones. This study shows that the coral rubble that collects at depths ranging from 2 to 12 m along the Mesoamerican Reef is a species-rich substrate that needs to be studied further. Some groups of isopods could be specially adapted to this type of substrate. Kensley (1984b), while studying the isopod species composition from coral rubble at Carrie Bow Cay, Belize, noted that anthuridean diversity was high. He considered that the slender and cylindrical body of anthurids is especially well suited to inhabit the interstices of this substrate. In this study, seven species of anthurids were recorded supporting Kensley's observations.

Kensley's monograph and book on Caribbean isopods (Kensley 1984a; Kensley and Schotte 1989) remain the two most important accounts of this fauna for the region. As is the case with many other invertebrate groups, isopods are highly diverse and needs to be included in biotic surveys and could provide indicator species for monitoring ecosystem health.

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